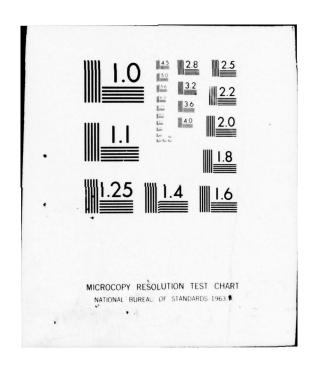
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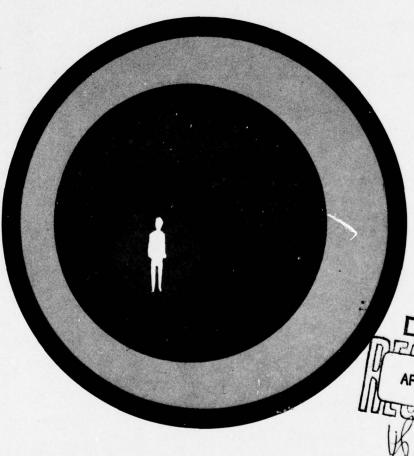
TAEG

TRAINING ANALYSIS AND EVALUATION GROUP

TAEG REPORT NO. 55

A GUIDEBOOK FOR ECONOMIC ANALYSIS IN THE NAVAL EDUCATION AND TRAINING COMMAND





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APRIL 1978



TRAINING ANALYSIS AND EVALUATION GROUP ORLANDO, FLORIDA 32813

A GUIDEBOOK FOR ECONOMIC ANALYSIS IN THE NAVAL EDUCATION AND TRAINING COMMAND

William M. Swope Eric K. Green

Training Analysis and Evaluation Group

April 1978

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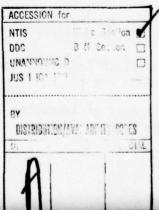
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SECTION I

INTRODUCTION

This guidebook on economic analysis was prepared by the Training Analysis and Evaluation Group (TAEG) in cooperation with the Resources Management Division (Code N-62) of the Chief of Naval Education and Training (CNET). It is designed to be used by individuals within the Naval Education and Training Command who lack experience and training in the techniques of economic analysis but who are required, aperiodically, to perform these analyses.

The guidebook is intended to provide a systematic step-by-step approach to economic analysis of resource allocation problems. Discussions of the concepts, assumptions, and principles underlying the analytical techniques employed are intentionally omitted. These underlying bases are well documented in numerous publications. Many of these sources are referenced in this report and are available for those desiring more detailed information. Throughout the guidebook a number of "rules of thumb" are offered. These are provided without explanation or justification in keeping with the intent of this document.

OBJECTIVE OF GUIDEBOOK

The objective of this effort is to develop a procedurally-oriented economic analysis guidebook. The document is designed for mid-level managers and for analysts who are charged with making resource allocation decisions. Accordingly, the techniques proposed center on short-run operational problems such as equipment acquisition, contracting, and consolidation or reorganization of training activities.

ORGANIZATION OF GUIDEBOOK

The economic analysis process has been separated into discrete tasks which must be performed sequentially. An orderly set of tasks has been identified, and forms and procedures are provided to facilitate the accomplishment of each task. Following an overview of the economic analysis process, each task is then described with a minimum amount of detail on procedures and formats. Abbreviated information and guidance for performing the task are given with each task description. References which have been selected as the most relevant for each task are given immediately following each task description. A more extensive list of references for each task can be found in appendix A, table A-1. Copies of a number of these references are held by the local comptroller's office while others may be available at station libraries. If not locally available, additional information about the references may be obtained from TAEG. The references are listed in detail at the end of the report. Appendix B provides two examples of economic analysis which utilize the procedures outlined in this report. Appendix C illustrates the mathematical derivation of the mid-year discount factors used by the Department of Defense (DOD). Appendix D contains a glossary of terms which are relevant to economic analysis.

OVERVIEW OF THE ECONOMIC ANALYSIS PROCESS

The overall purpose of an economic analysis is to identify and cost all resources required by each alternative and then, given the benefits of each alternative, determine that alternative which is most cost effective. An outline of the economic analysis process is illustrated by the block diagram in figure 1. The sequential tasks illustrated in figure 1 offer a simplified procedure for identifying a set of alternatives, determining the resources required by each alternative, and then comparing the cost and benefits of the alternatives to determine which alternative is most cost effective. Task 1 through task 4 must be done only once for each analytical problem. The set of feasible alternatives identified in task 4 determines the number of times tasks 5 through 10 must be executed for each problem. For example, if there are four alternatives identified in task 4 then tasks 5 through 10 must be iterated four times. Finally, in task 11, the data developed in the previous tasks are used to compare all alternatives and the most cost effective alternative is recommended.

GUIDEBOOK LIMITATIONS

An economic analysis will seldom lead to cost estimates which are consistent with the budget data. This inconsistency arises because (1) economic analysis is concerned with the efficiency in the use of capital resources (i.e., resources which are already in the inventory) and (2) the time value of resources is made a part of the analysis. An economic analysis estimates the value of existing capital from the yield of the best available alternatives (called its opportunity cost) and includes this value as part of the cost. Budget data generally do not include the opportunity costs of resources in current inventory. Finally, all future benefits and costs are discounted because resources (or monies) received (or used) today are worth more than those monies received or used in the future. Discounting permits cost and benefit streams with different time phasing to be compared on an equal basis. Since economic analysis deals with discounted costs and benefits, the dollar flows shown in the analysis differ from those in the budget.

The forms illustrated throughout the guidebook are not intended for reproduction and general use in preparing an economic analysis. They have been deliberately compressed for expediency in presentation. However, for those individuals concerned with short planning periods the forms may be used without modification. The forms depict a general format which serves as the basis for preparing more extensive forms for specific analysis. Alternative forms which can also be used are described in DOD Instruction 7041.3.

Users are admonished not to expect every contingency encountered in doing an economic analysis to be covered by procedures outlined in this guide-book. Problems encountered in conducting an economic analysis are often so divergent that it is inevitable that the analysts will frequently need to exercise individual resourcefulness in applying these procedures to their problems.

Assistance in economic analyses can be obtained by calling TAEG (autovon 791-4367) or the Analysis Branch, CNET, Code N-62 (autovon 922-3407).

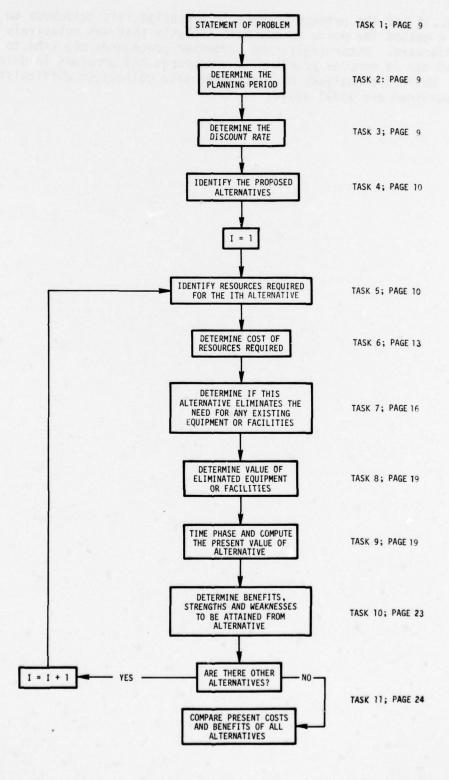


Figure 1. Outline of the Tasks Necessary to Perform an Economic Analysis

Finally, it was the primary purpose in preparing this guidebook to develop and present a method for doing an economic analysis that was relatively simple and straightforward. Accordingly, the suggested procedures may tend to oversimplify what may be complex problems in procedures and problems in data collection. While the analysts may encounter data collection difficulties the procedures outlined are still valid.

SECTION II

DESCRIPTIONS OF TASKS

TASK 1. STATEMENT OF PROBLEM

DISCUSSION: Provide a brief statement explaining the problem to be analyzed giving the objectives, problem characteristics, constraints on the problem solution, and any relevant study assumptions.

REFERENCES: No. 1, pp. 2 and 3; No. 2, p. 3; No. 3, p. 3.

TASK 2. DETERMINE THE PLANNING PERIOD

DISCUSSION: Costs and benefits of any program are seldom limited to one year. Therefore, a decision must be made as to the time frame over which the analysis is to extend. It is necessary to specify a time period in order that alternative solutions can be realistically compared. The time period will frequently be dictated by the problem. For example, commercial/industrial (C/I) analyses usually require 3 years. In other situations, it may be convenient to use a planning period which coincides with expected life of the equipment or instructional material. In other situations, the planning period may be determined by administrative edict. If no justification or direction is available to determine the planning period, then use a period of 10 years.

REFERENCES: No. 1, p. 5; No. 2, pp. 12 and 13; No. 13, pp. 7 and 8.

TASK 3. DETERMINE THE DISCOUNT RATE

DISCUSSION: One of the major differences between economic analysis and cost analysis is that the time value of money (the medium to purchase resources) is considered in economic analysis. Money is a commodity; its price is the interest rate. One dollar deposited in a savings account will at the end of a year yield the dollar plus interest. Therefore, if a person is given the choice of receiving a dollar now or a dollar l year from now, the logical choice would be to accept the dollar today because, if invested, the dollar could be returned with interest l year later.

Discounting is a method which calculates the "present value" of dollars to be spent or received in the future. By present value is meant the worth today of some future dollar amount. The price of money, the interest rate, is used as the basis for determining the discount (present value) rate (see appendix C). The discount rate is used to compute a discount factor which, when multiplied by the future money amount, will give the present value of the future money amount.

In order to compare the cost of different alternatives (where expenditures are made in various time periods), the present value of the cost of each alternative must be determined. Given all other things being equal, the alternative with the lowest present value cost should be selected (this assumes all alternatives are of equal effectiveness).

A great deal of controversy exists over the proper discount rate to use to determine present values. The current DOD Instruction 7041.3 directs that "future benefits and costs will be discounted at an annual rate of 10 percent." The analyst is permitted to prepare an analysis using an alternative discount rate that he believes more applicable, provided he submits this as a supplement to the analysis using the prescribed 10 percent rate. Table 1 includes the discount factors computed from a 10 percent discount rate (price of money). Notice that the discount factors decrease over the future years; this means that the further in the future a dollar is received (or spent) the less it is worth today. Table 1 also includes discount factors listed for integer discount rates of 4 percent through 12 percent to cover the contingency of future amendments to the current DOD instruction.

REFERENCES: No. 1, pp. 14 through 17; No. 2, pp. 13 through 24; No. 3, pp. 25 through 28; No. 10, pp. 12 and 13.

TASK 4. IDENTIFY THE PROPOSED ALTERNATIVES

DISCUSSION: Alternate methods of accomplishing the objectives outlined in task I must be specified. The identification of alternatives is best accomplished by those skilled in the technical aspects of the problem. The status quo (i.e., continue to do business as usual) and the contracting for the function are examples of alternatives which might be included. Only very general specifications of alternatives are necessary for task 3. However, the analyst must comprehensively examine tasks 5 through 10 for each alternative, as results from those latter tasks will yield the information from which comparisons can be made.

REFERENCES: No. 1, pp. 3 through 5; No. 2, p. 4; No. 3, pp. 12 through 14; No. 10, pp. 4 and 5.

TASK 5. IDENTIFY RESOURCES REQUIRED

DISCUSSION: For each alternative identified in task 4 an identification of the physical resources required for the execution of that alternative must be specified. These resource requirements must be identified for each year in the planning period (as determined in task 2) according to the year in which they will be needed.

If the alternative being analyzed is a contract price and the government is not providing supplies or facilities, there will be no requirement for acquisition of in-house resources and consequently no requirement for doing task 5. In that case, go directly to task 6.

There are certain classes of resources and/or functions for which it would be too difficult and laborious to itemize each resource item required. For these, direct cost estimates may be made. For example, general supplies or the refurbishing of facilities may involve so many different items that an

²For projects where costs extend over 3 years or less, discounting is not required (DOD Instruction 7041.3).

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TABLE 1. DISCOUNT FACTORS FOR DISCOUNT RATES BETWEEN 4 PERCENT AND 12 PERCENT¹

		DISC	OUNT FAC	TORS BAS	ED UPON	DISCOUNT	RATES C	F:	
Year	. 04	.05	.06	.07	.08	.09	.10	.11	.12
1	.981	.976	.972	.967	.963	.959	.955	.950	.946
2	.943	.930	.917	.904	.892	.880	.868	.856	.845
3	.907	.885	.865	.845	.826	.807	.789	.771	.754
4	.872	.843	.816	.790	.764	.740	.717	.695	.674
5	.838	.803	.770	.738	.708	.679	. 652	.626	.601
6	.806	.765	.726	.690	.655	.623	.593	.564	.537
7	.775	.728	.685	.645	.607	.572	.539	.508	.479
8	.745	.694	.646	.602	.562	.524	.490	.458	.428
9	.717	.661	.610	.563	.520	.481	.445	.412	.382
10	.689	.629	.575	.526	.482	.441	.405	.371	.341
11	.663	.600	.543	.492	.446	.405	.368	.335	.305
12	.637	.571	.512	.460	.413	.372	.334	.302	.272
13	.613	. 544	.483	.420	.382	.341	.304	.272	.243
14	.589	.518	.456	.401	.354	.313	.276	.245	.217
15	.566	.493	.430	.375	.328	.287	.261	.220	.194
16	.545	.470	.405	.351	.305	.263	.228	.197	.173
17	.524	.447	.383	.328	.281	.241	.208	.179	.154
18	.503	.426	.361	.306	.260	.222	.189	.161	.138
19	.484	.406	.340	.286	.241	.203	.172	.145	.123
20	.466	.386	.321	.267	.223	.186	.156	.131	.110
21	.448	.368	.303	.250	.207	.171	.142	.118	.098
22	.430	.350	.286	.234	.191	.157	.129	.106	.088

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TABLE 1. DISCOUNT FACTORS FOR DISCOUNT RATES
BETWEEN 4 PERCENT AND 12 PERCENT (continued)

Vanu		DIS	COUNT FA	CTORS BA	SED UPON	DISCOUN	T RATES	OF:	
Year	. 04	. 05	.06	.07	.08	.09	.10	.11	.12
23	.414	.334	.270	.218	.177	.144	.117	.096	.078
24	.398	.318	.254	.204	.164	.132	.107	.086	.070
25	.383	.303	.240	.191	.152	.121	.097	.078	.062

¹Mid-year discount factors

effort to list them would be meaningless. In that case, fairly reliable estimates of the costs of supplies can be derived from past expenditure patterns. A cost estimating relationship (CER) must be derived and used to make direct cost estimates. A cost estimating relationship is simply a means of relating costs of production to output levels and may take such forms as dollars per student, dollars per student hour, dollars per instructor, or dollars per square foot.

Completion of table 2 will identify and time phase the resources required for each alternative. Column one identifies the resource, column two identifies the units of measurement, and the remaining columns indicate the number of units required for each year. The number of years in the planning period (N) would be determined from task 2.

When direct cost estimates are made, the units of measurement shown will be dollars and the funding required for each year of the planning period would be entered in the appropriate columns of table 2.

REFERENCES: No. 3, pp. 14 through 18; No. 15, pp. 7 through 9; No. 19, pp. 12 through 13.

TASK 6. DETERMINE COST OF RESOURCES REQUIRED

DISCUSSION: The next step in the process is to determine the economic cost of all resource items that will be required to implement and operate each alternative for the planning period. These resource items might be classified in five main groups as suggested in task 5: Personnel, Supplies, Equipment, Facilities, and Other. The process illustrated in figure 2 can be used as a guide for costing each individual item in the resource group. The initial step is to determine if the resource is already available within your command/organization or if the resource will have to be purchased or acquired. If the resource is not available in-house, then the cost of the resource is simply the purchase or acquisition price. For example, if a truck is the resource required and none is available in-house, then the truck must be purchased (or rented) and its purchase price is the acquisition cost.

The more difficult part of this task is determining the value or cost to be placed on resources which are already in-house. Assume, for example, that a truck is required and that an adequate truck is already owned by the organization. The first step in placing a value on the truck is to make a determination if it is being currently used or if it is in surplus. If it is not currently being used, then it can be employed in this alternative without denying its use for some other in-house purpose and the cost depends on whether the truck would have been disposed. When it cannot be disposed, the cost of the truck is zero. If it can be disposed, the cost is equal to its market or salvage value. Note that the salvage value or market value of any unused resource should be used only if the resource would have been sold; otherwise, the cost of using the resource is zero.

TABLE 2. FORMAT FOR COLLECTING DATA ON RESOURCES REQUIRED FOR EACH ALTERNATIVE

RESOURCE	RESOURCE MEASURE-	-	RESOURCES	WHICH MUST	QUANTITY OF RESOURCES WHICH MUST BE ACQUIRED IN EACH YEAR	EACH YEAR
GROUP		-	2 3	4	5 6	2
3/0						
Equipment						
Personnel						
Supplies						
Facilities						
Other						

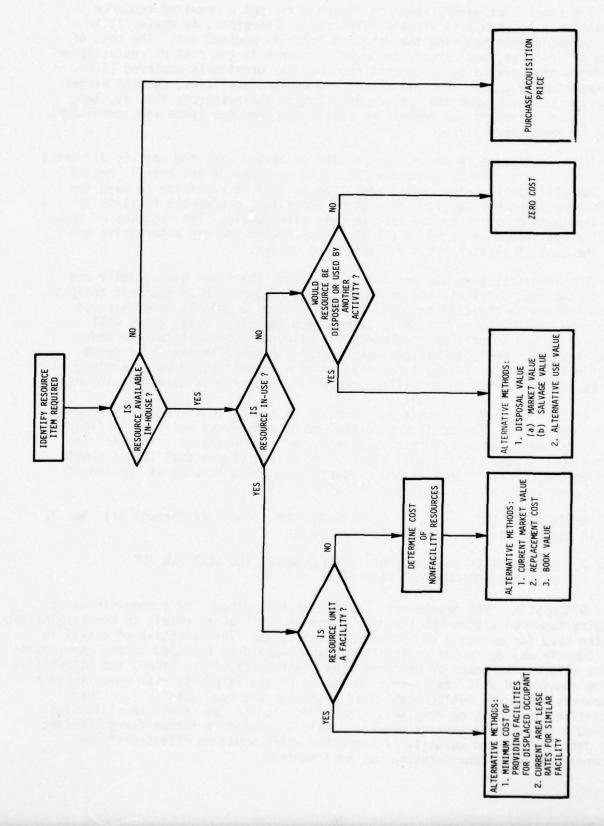


Figure 2. A Diagrammatic Scheme for Determining Cost of Resources Required for Each Alternative System

The other contingency shown in figure 2 is that a required resource is available in-house but is already being used. Therefore, to employ it in a new use would mean removing the resource from its present use. The cost of using an in-house, but already employed, resource is the cost of replacing or providing the service in which that resource was previously employed (i.e., its opportunity cost). For all resources, except facilities, current market value can be based upon the replacement cost of the resource; that is, the price you must pay if you bought the exact same resource (same age, condition, etc.) in the market place.

With facilities, however, the problem of determining the cost is different. If a facility is already completely occupied and some of the area is needed for the alternative being considered, then it will be necessary to have the current occupant displaced. The cost of providing an adequate facility for the displaced occupant is the cost to this alternative. The decision of whom to displace should be based on (1) the space needed for the alternative and (2) the cost of shelter for the displaced occupant.

The identification and costing of resources which are used jointly are two of the most difficult and ambiguous tasks required in an economic analysis. Unless otherwise directed or required, the cost of a jointly used resource should be determined on the basis of how much (marginal cost) costs will increase if the jointly used resource is employed in the alternative under consideration. For alternatives which result in the elimination of joint functions, the cost savings to be claimed as a credit should be determined on the basis of how much costs will decrease if a resource is used less intensely.

Table 3 provides a format for summarizing the costs of resources used by each alternative. The costs are determined by procedures outlined in figure 2. Costs should be entered for each resource item in the year in which the expenditures (acquisition) will occur. The column of residual values should include the value, if any, of any resource item which remains at the end of the planning period (i.e., at the end of year N).

REFERENCES: No. 1, pp. 10 through 20; No. 2, pp. 41 through 51; No. 3, pp. 18 through 27; No. 10, pp. 40 through 50.

TASK 7. DETERMINE IF THIS ALTERNATIVE ELIMINATES THE NEED FOR ANY EXISTING EQUIPMENT OR FACILITIES

DISCUSSION: The development of alternative methods for accomplishing an ongoing function within the training community will often result in the elimination of the need for existing equipment and facilities. The objective of task 7 is to identify any equipment or facilities which would be released by the development of an alternative means of performing an ongoing activity. Often, the alternative being considered will result in a reduction of the intensity with which certain resources are used, but because these resources are used jointly for other activities they must be retained. This reduction in use cannot be claimed as a credit unless cost savings result. Table 4 provides a format for collecting the data by type and quantity of resources which would be released if the alternative under consideration was implemented.

FORMAT FOR SUMMARIZING THE RESOURCE COSTS OF EACH ATERNATIVE TABLE 3.

RESOURCE	RESOURCE	COST OF RESOURCES WHICH MUST BE ACQUIRED IN EACH YEAR	RCES WI	IICH ML	ST BE AC	QUIRED	IN EACH YEAR		RESIDUAL	
GROUP	ITEM	1 2 3		4	2	9		z	VALUE	
Edulpment	6.1640403									
	Subcocal									
Personnel										
	Subtotal									
Supplies										
	Subtotal									
Facilities										
	Subtotal									
Other										
	Subtotal									
	TOTAL COSTS									
										_

TABLE 4. FORMAT FOR COLLECTING DATA ON THE RESOURCES RELEASED BY EACH ALTERNATIVE

RESOURCE	RESOURCE	MEASUREMENT	QUANT	TY OF	QUANTITY OF RESOURCES RELEASED BY YEAR RELEASED	RELEASE	D BY YE	AR REL	EASED	
GROUP	ITEM	UNITS	1	2	8	4	:		z	
Equipment										
Facilities										
Personnel										
						,				
						,	The second secon		The state of the s	1

REFERENCES: No. 2, pp. 43 and 44; No. 3, p. 25; No. 10, p. 43.

TASK 8. DETERMINE VALUE OF ELIMINATED EQUIPMENT OR FACILITIES

DISCUSSION: A cost for the resources identified in task 7 must be determined so that a proper credit can be given to the alternative under consideration. Figure 3 illustrates a procedure for computing the value of resources which might be released by the proposed alternative. If the resource or surplus capacity released has no other use, then the cost (i.e. the opportunity cost) of using that resource for the proposed alternative would be zero and no credit can be claimed.

The costs which the receiving activity can avoid should be used as the value of any surplus capacity which would be released. When it is not possible to obtain data for determining the value of the cost avoidance, then use an estimated sale (or market) price for the equipment or facilities. Support can be requested from the local representative of the Naval Facilities Engineering Command for determination of estimates for facilities. Table 5 provides a format which can be used to summarize the value of the resources which might be released. These values can be determined by applying the procedures outlined in figure 3 to the resources identified in table 4.

REFERENCES: No. 2, pp. 43 and 44; No. 10, p. 43.

TASK 9. TIME PHASE AND COMPUTE THE PRESENT VALUE OF ALTERNATIVE

DISCUSSION: Results from task 9 are intended to yield a summary of the information developed in the previous tasks. The additional resource requirements and their associated costs were identified in tasks 5 and 6. The resources released, if any, and their associated values were identified in tasks 7 and 8. All data is now ready to be compiled into a total life cycle cost for each alternative.

Table 6 provides a format for summarizing the cost data. The resource requirements will have been time phased in previous tasks and can be directly transferred to this form. Total annual (i.e., for years 1, 2, 3...N) costs for resources required are summarized in row 6. The final column in row 6 is a summary of all resource items which will have a residual value at the end of the planning period.

The total value of released assets is summarized in row 10 for all resource items which can be eliminated. The values are shown by the year in which they can be eliminated. The net per year cost for each year in the planning period is obtained by subtracting elements in row 10 from elements in row 6. The result is the net annual costs and they are entered in row 11.

The discount factor is entered in row 12 for each year in the planning period. The discount factor is computed on the basis of the discount rate selected in task 3. Table 1, page 11, presents the mid-year discount factors for integer discount rates from 4 percent through 12 percent. The current DOD

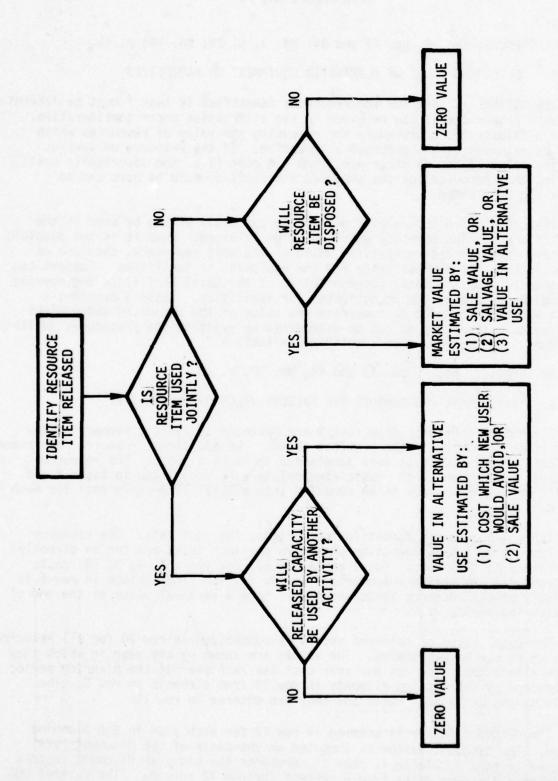


Figure 3. Procedure for Determining Value of Resources Released

TABLE 5. FORMAT FOR SUMMARIZING THE VALUE OF RESOURCES RELEASED BY EACH ALTERNATIVE

		z				
		:				
	ASED	9				
	RELE					
	YEAR	2				
	ES BY					
	VALUE OF RESOURCES BY YEAR RELEASED	4				
	F RES					
	LUE 0	3				
	VA					
		2				
1						
	ñ					
	FCOLIB	ITEM				
1	<u> </u>					

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·

RESIDUAL VALUE OF RESOURCES z TABLE 6. FORMAT FOR SUMMARIZING THE TOTAL COSTS OF EACH ALTERNATIVE 9 2 4 2 (11)x(12) = (13)(11) = (01) - (9)(12)(2) (6) Equipment (1) Facilities(2) Personnel (3) Supplies (4) Subtotal (6) Equipment (7) Facilities(8) Subtotal (10) RESOURCE GROUP 0ther 0ther DISCOUNTED RESOURCES REQUIRED NET RESOURCES REQUIRED RESOURCES RELEASED DISCOUNT ITEM

Present Value of Alternative =

instruction specifies that analyses within DOD are to be based upon the 10 percent discount rate. The discounted value in row 13 is computed by multiplying the net resources (row 11) by the discount factor (row 12). The residual value of resources is discounted using the N^{th} year discount factor. The discounted value is computed for each year in the planning period and entered in row 13. The present value of the alternative is computed by cumulating the discounted values (in row 13) over all years and subtracting, from the resultant sum, the discounted residual value (found in the last column of row 13).

REFERENCES: No. 2, pp. 13 through 24; No. 3, pp. 25 through 37; No. 10, pp. 10 and 11.

TASK 10. DETERMINE THE BENEFITS, STRENGTHS, AND WEAKNESSES TO BE ATTAINED FROM ACCEPTING AND IMPLEMENTING THE ALTERNATIVE

DISCUSSION: Results generated by this task should provide a qualitative assessment of the alternatives, other than the quantitative cost analysis completed in task 9. The analysis and evaluation of most alternatives deal with some qualitative aspects, which are not subsumed under the cost analysis. It is possible that these qualitative aspects could be so important as to outweigh any cost impacts which one might project. It is the purpose of this task to identify and evaluate any such noncost factors. Managers must include the nonquantifiable (i.e., the noncost factors) characteristics of each alternative into their decisionmaking process if they intend to reach the most rational decision. A few of the qualitative factors which should be addressed are: reliability, manageability, acceptability, impact on morale, safety, external constraints, and adaptability to change. Any caveats concerned with the analysis should be explicit.

Any noncost benefits obtained should be stated in terms of the problem statement defined in task 1. Assume, for example, that the problem statement was to determine the most cost-effective method of providing refuse disposal for a military installation. Assume further that the alternative under consideration is a proposal for contracting and we need to determine the nancost benefits and impacts from contracting this service. An example of a benefit/impact statement might be as follows:

- a. Contracting will provide for refuse pickup three times per week rather than a daily pickup under the current operation.
- b. Contracting will only provide for pickup between the hours of 0800 to 1700.
- c. Additional charges at the rate of \$30 per hour will be made for contingency pickups outside the hours 0800 to 1700.
- d. All refuse must be separated into combustible and noncombustible material.

~

These factors or considerations are of the type that cannot readily be included under a cost analysis yet may be very important in the decision to contract or not to contract.

Upon completion of task 10, the analysts must determine if all alternatives have been considered. If there are other alternatives, then tasks 5 through 10 must be executed for each. The final data package will include a set of analyses for tasks 5 through 10 for each alternative under consideration. In task 11 the data packages will be compared for all alternatives.

REFERENCES: No. 1, pp. 22 through 31; No. 2, pp. 53 through 60; No. 3, pp. 27 through 30; No. 10, p. 60.

TASK 11. COMPARE PRESENT COSTS AND BENEFITS OF ALL ALTERNATIVES

DISCUSSION: The final step in the economic analysis process is to use the data and information derived from the preceding tasks to compare each of the proposed alternatives. The selection of the most cost-effective alternative will occur within one of the following four situations:

Equal benefits - Unequal costs
Equal benefits - Equal costs
Unequal benefits - Equal costs
Unequal benefits - Unequal costs

The most common situation used within the Naval Education and Training Command is situation one; equal benefits - unequal costs. This situation is most relevant because our training programs are usually designed to train to certain criteria. Thus, the required performance level of any training program is presumed to be the same, and training alternatives are designed only to provide the specified level of performance. Those alternatives which do so at lowest cost are most efficient. There are many areas, other than training, for which situation one applies; e.g., hardware acquisition, service contracts, and facilities maintenance all specify performance criteria for which minimum cost alternatives are selected.

Situation two, equal benefits - equal costs, will occur so infrequently that for most problems this contingency can be ignored as insignificant. When it does occur, decisions are made based solely on criteria such as that developed in task 10.

Situation three, unequal benefits - equal costs, is a situation that one should not expect to encounter very frequently. Unfortunately, it does occasionally occur as a result of the lead time required for budget submissions. Too often specific funds are identified for projects or programs occurring in the out years; then as the projects are developed the identified fund levels are taken as given parameters. Very little marginal analysis is done to determine the benefits which might be gained from alternative funding levels.

In any event, economic analysis can provide useful management information by identifying those alternatives which yield the maximum benefits for any given level of expenditure.

Situation four, unequal benefits - unequal costs, is probably the most frequent situation when a literal and very rigorous approach is taken in the analysis. Situation four becomes the most difficult to evaluate because an evaluation will require a good deal of judgment, or subjectivity, on the part of the decision maker. While we intuitively suspect that alternative configurations of training resources will impact on the amount the student learns, we lack rigorous methods to develop empirical measures of the amount of training or education which has taken place. As a result, most analyses of training problems start from some fixed performance levels and then attempt to find the resource configuration which will meet those performance levels at minimum cost. Thus, most analyses of training problems are done under situation one above.

REFERENCES: No. 1, pp. 32 through 34; No. 2, pp. 53 through 60; No. 3, p. 30; No. 10, pp. 53 through 61.

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ADDITIONAL POLICY DIRECTIVES RELEVANT TO ECONOMIC ANALYSIS

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- Department of the Navy. <u>Commercial or Industrial (C/I)</u> Activities <u>Program.</u> NAVMATINST 4860.12.
- Department of the Navy. Naval Material Command Cost Analysis/Estimating Program. NAVMATINST 7000.19A.
- Department of the Navy. <u>Commercial or Industrial Activities Program.</u> CNETINST 4860.1.
- Department of the Navy. <u>Commercial or Industrial (C/I) Activities Program.</u>
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- Department of the Navy. <u>Project Engineering Documentation (PED)</u> for <u>Proposed</u>
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- Department of the Navy. Shore Facilities Energy Conservation Survey Program. NAVFACINST 4100.6.

APPENDIX A

ADDITIONAL REFERENCES FOR TASKS

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		TA	TABLE A-1.	COMPREHENSIVE LIST OF REFERENCES FOR EACH TASK	VE LIST OF	REFERENCE	S FOR EACH	TASK			
REFERENCE NUMBER	TASK 1	TASK 2	TASK 3	TASK 4	TASK 5	TASK 6	TASK 7	TASK 8	TASK 9	TASK 10	TASK 11
					(Page Number)	mber)					1
-	2-3	5	14-17	3-5		10-20				22-31	32-34
2	3	12-13	13-24	4		41-51	43-44	43-44	13-24	53-60	53-60
8	11-12	37-39	25-28	12-14	14-18	18-27	25		25-37	27-30	30
4	23-25	213	205-218	118-119		165-177	173-174				
2	18-21	13-15		21-24		10					
9	10		119-125	22-25		26-37					
7	14-15			18-19		22-27					
80	2.5-2.9			2.10-2.17		2.43-2.54					
6	79,89					21-33					
10	3		12-13	4-5		40-50	43	43	10-11	09	53-61
=	1-3;6-7			10-17		10-17					
12	2-6										
13		7-8	2-7	1-2		5-9	4	4			
14		06									
15		9-10	10-12	9-9	7-9						13-15
16			1-6	1-4					1-7		
17			1-27								
18				6-15		124-127					
19				12-13	12-13	12-13					
20				1-9							
12				1-10							
22				1-4		472-476					463-480
23						92-99					
24						3.1-3.16					
25						=					
26											
27								226-285	85		

APPENDIX B
EXAMPLES OF ECONOMIC ANALYSIS

EXAMPLE 1: A Preliminary Investigation into a Commercial/Industrial (C/I) Function

Task 1: Determination of least cost custodial services at NATTC Hard Knocks. This would be a preliminary analysis only, as the format and cost factors are rigorously specified for an actual C/I cost analysis of any function when justification for in-house performance is based on cost.

Task 2: Administrative policy sets a planning period of 3 years for functions which are considered a C/I activity.

Task 3: As set forth in DOD Instruction 7041.3, a discount rate does not need to be employed for projects which have planning periods of 3 years or less.

Task 4: Two alternatives will be evaluated for acquiring custodial service: (1) employ in-house resources or (2) contract with the private sector.

Task 5: The resources required to complete the task in-house are listed in table B-1.

Task 6: The costs of resources for the in-house alternative are listed in table B-2. Supplies and miscellaneous expenditures have already been estimated. Additional civilian personnel will have to be hired at the WG 2 and 3 levels and 20.4 percent will be added to their base pay to account for fringe benefits. Also, there will be a 3.4 percent annual inflation factor for WG salaries. A 4.7 percent factor is used for GS and a 4.54 percent factor for military (use latest factors). In a preliminary analysis such as this, contract costs could be approximated based on existing contracts for similar functions, or from engineering estimates. When conducting the C/I cost analysis in accordance with NAVMATINST 4860.12A, contract costs must be obtained from contractors using the firm bid/offer procedure.

	Year 1	Year 2	Year 3
Cost	\$314,500	333,400	353,400

Task 7 - 9: Not applicable since no resources will be released and discounting is not required.

Task 10: The basic strength of the in-house alternative is direct control; the basic weakness is an increase in bureaucracy. The basic strength of a private contractor is greater flexibility. However, costs may rise significantly when contract comes up for renewal with no ceiling points available to convert back to in-house.

TABLE B-1. RESOURCES REQUIRED FOR IN-HOUSE CUSTODIAL SERVICES

Civ Pers Mil Pers Maint & Rep Insurance, etc	RESOURCE	RESOURCE	MEASURE-	QUANTITY	OF RESO	QUANTITY OF RESOURCES WHICH MUST BE ACQUIRED IN EACH YEAR	MUST B	E ACQUIR	KED IN E	ACH YEAR	
Civ Pers Man-years 24 24 24 Mil Pers	GROUP	ITEM	MENT UNITS	1	2	3	4	5			z
Civ Pers Man-years 24 24 Mil Pers	Equipment										
es ties Insurance, etc. \$ 11,600 11,600		Civ Pers	Man-years	24	24	24					
ties Maint & Rep \$ 5,000 5,310 ²	Personnel	Mil Pers'									
ties Insurance, etc. \$	Supplies	Maint & Rep	49			5,639 ²					
Insurance, etc. \$	Facilities										
	Other			11,600	11,600	11,600					

1 Impossible due to fluctuating military labor pool.
2 Inflation factor of 6.2 percent for materials (use latest factor).

FORMAT FOR SUMMARIZING THE RESOURCE COSTS OF EACH ALTERNATIVE TABLE 8-2.

RESOURCE	RESOURCE	COST OF RESOURCES WHICH MUST BE ACQUIRED IN EACH YEAR	ICH YEAR	RESIDUAL
GROUP	ITEM	1 2 3 4 5 6	z	VALUE
Equipment				
	Subtotal			
Personnel	Civ (WB 2 & 3)	218,400 226,000 233,500		
	Subtotal			
	Maint & Repair	5,000 5,310 5,639		
Supplies				
	Subtotal			
Facilities				
	Subtotal			
	Insurance, etc.	11,600 11,600 11,600		
Other				
	Subtotal			
	TOTAL COSTS	235,000 242,910 250,739		

Inflation factor for GS = 4.7%, WB = 3.4%, military = 4.54% (use latest factors).

Task 11:

Below is a listing of the annual costs, nondiscounted, of both alternatives. It is obvious that for each year the in-house alternative is the cheaper and therefore is the alternative which should be selected. As the in-house alternative is the cheaper, the need for the full C/I cost analysis is indicated. If the contract alternative had been cheaper, the contract could have been awarded without further analysis.

Cost of Alternatives

	Year 1	Year 2	Year 3	Total Cost
In-house	\$235,000	242,910	250,739	728,649
Contract	314,500	333,400	353,400	1,001,300

EXAMPLE 2: Economic Analysis of CNET Publishing System

- Task 1: Determination of the most cost effective publishing system for CNET.
- Task 2: The planning period will be 10 years as no other direction is given.
- Task 3: As set forth by DODINST 7041.3, a discount rate of 10 percent will be used. The following are the discount factors for years 1 through 10:

Year	Factor
1	.955
2	.868
3	.789
4	.717
5	.652
6	.593
7	.539
8	.490
9	. 445
10	. 405

- Task 4: There are two publication systems under consideration: (1) the current system and (2) text editor based system. The first analysis will be of the current system.
- Task 5A: Table B-3 lists the resources that will be required for the current publication system.
- Task 6A: Table B-4 shows the costs of the resources required to execute the current publication system.

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25.8 43.3 85.5 306.7 38.7 4321.6 100.2 3803.1 Z 14 18 BE ACQUIRED IN EACH YEAR 43.3 25.8 100.2 306.7 38.7 4321.6 3803.1 85.5 9 38 14 25.8 43.3 85.5 100.2 38.7 4321.6 306.7 3803.1 2 14 18 RESOURCES WHICH MUST 100.2 25.8 43.3 85.5 38.7 4321.6 306.7 3803.1 28 4 14 25.8 43.3 100.2 85.5 306.7 38.7 4321.6 3803.1 38 3 14 25.8 43.3 85.5 100.2 306.7 38.7 4321.6 3803.1 2 14 38 PF QUANTITY 25.8 43.3 85.5 100.2 38.7 4321.6 3803.1 306.7 18 14 000s plates Million pgs 000s binds MEASURE-MENT UNITS 000s negs Man-years Man-years Man-years Man-years Typeset/Illust. Mag-Card IIs Encoding/ Composing **Typewriters** RESOURCE ITEM Authoring Negatives Printing Editing Binding Plates MTSCs VDTs Facilities Equipment Personnel RESOURCE GROUP Supplies Other

A LIST OF RESOURCES REQUIRED FOR CURRENT PUBLICATION SYSTEM

TABLE B-3.

N = 10 years

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	RESIDUAL	VALUE									751								
ON SYSTEM	N EACH YEAR	_z	96	8	66	6,517	952	746	8,215					•	5,907	165	6,072	14,386	
THE COST OF RESOURCES REQUIRED FOR THE CURRENT PUBLICATION SYSTEM (Thousand dollars)	COST OF RESOURCES WHICH MUST BE ACQUIRED IN EACH YEAR	9	96	3	66	6,517	952	746	8,215			Ť	•		5,907	165	6,072	14,386	
IE CURREN	MUST BE	5	96	3	66	6,517	952	746	8,215						5,907	165	6,072	14,386 14,386 14,386 14,386 14,386 14,386	
dollars)	ES WHICH	4	96	3	66	6,517	952	746	8,215						5,907	165	6,072	14,386	
housand	RESOURC	3	96	8	66	6,517	952	746	8,215		1				5,907	165	6,072	14,386	
(T)	COST OF	2	96	3	66	6,517	952	746	8,215		V				5,907	165	6,072	14,386	
COST OF R		-	96	3	66	6,517	952	746	8,215						5,907	165	6,072	14,386	
TABLE B-4. THE	RESOURCE	ITEM	Rental/lease	Maintenance	Subtotal	Authoring	Editing/Encoding	Comp/Type/Illust.	Subtotal		Subtotal			Subtotal	Printing	Platemaking	Subtotal	TOTAL COSTS	
	RESOURCE	GROUP		Factionent	200		Personnel			Supplies		Facilities				0ther			

N = 10 years

Task 7A: The current publication system will not eliminate the need for

any existing equipment or facilities.

Task 8A: N/A (see Task 7)

Task 9A: Table B-5 presents a summary of the costs of the current publication system.

Task 10A: The main benefit of staying with the current system is that no risk is involved; it is a time tested system and it works. However, this system does not have the flexibility that is sometimes required.

The second alternative which must be analyzed is the text editor system. The following execution of tasks 5 through 10 presents the analysis for the text editor system:

Task 5B: Table B-6 lists the resources that will be required by the text editor publication system.

Task 6B: Table B-7 shows the costs of the resources required to execute the text editor publication system.

Task 7B: Implementing this alternative would eliminate the need for the equipment used by the current system (see task 5 for a listing).

Task 8B: The equipment to be disposed has little or no value as it is old and obsolete.

Task 9B: Table B-8 presents a summary of the costs of the text editor publication system.

Task 10B: The text editor system requires a substantial commitment for new equipment. This equipment offers greater flexibility for the system.

Task 11:

Both the current publication system and the proposed text editor system will satisfy CNET's publication requirements. Therefore, it is assumed that the benefits of each are equal. The present costs of each, however, are unequal. Over the planning period, the text editor system would cost approximately \$10 million less (discounted \$), given the benefits are equal. The text editor system is clearly more cost effective and would be recommended if the decision is to be based on cost savings alone.

TABLE B-5. SUMMARY OF COST OF CURRENT SYSTEM ANALYSIS (Thousand dollars)

ILEM	RESOURCE			ST (VALUI	E) OF RE	COST (VALUE) OF RESOURCES REQUIRED (RELEASED) BY YEAR	REQUIRED	(RELEAS	ED) BY YE	1		VALUE OF RELEASED
	GROUP	-	2	e l	4	2	9	7	8	6	10	RESOURCES
e Marie	Equipment	66	66	66	66	66	66	66	66	66	66	
	Facilities	0	0	0	0	0	0	0	0	0	0	
RESOURCES	Personnel	8,215	8,215	8,215	8,215	8,215	8,215	8,215	8,215	8,215	8,215	
REQUIRED	Supplies	0	0	0	0	0	0	0	0	0	0	
	Other	6,072	6,072	6,072	6,072	6,072	6,072	6,072	6,072	6,072 6,072 6,072 6,072 6,072 6,072	6,072	
	Subtotal	14,386	14,386 14,386 14,386 14,386 14,386 14,386 14,386 14,386 14,386 14,386	14,386	14,386	14,386	14,386	14,386	14,386	14,386	14,386	
	Equipment											
RESOURCES	Facilities											
RELEASED	Other											
	Subtotal	0	0	0	0	0	0	0	0	0	0	
NET RESOURCES REQUIRED		14,386	14,386 14,386 14,386 14,386 14,386 14,386 14,386 14,386 14,386	14,386	14,386	14,386	14,386	14,386	14,386	14,386	14,386	
DISCOUNT		.955	898.	.789	717.	.652	.593	.539	.490	.445	.405	
DISCOUNTED		13,739	13,739 12,487 11,351 10,315 9,380 8,531 7,754 7,049 6,402 5,826	11,351	10,315	9,380	8,531	7,754	7,049	6,402	5,826	

Present Value of Alternative - 92,834

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RESOURCE ITEM MENT UNITS 1 2 3 4							-			
TTEM MENT UNITS	RESOURCE	RESOURCE	MEASURE-	QUANTITY	OF RESO	JRCES WH	ICH MUST	BE ACQU	BE ACQUIRED IN EACH YEAR	YEAR
4-Terminal	GROUP	ITEM	MENT UNITS	1	2	3	4	5	9	LN .
Serwinal 1 1 1 1 1 1 1 1 1		4-Terminal Text Edit		3	3	က	က	ю	က	3
Cluster Type Compos. System I	Equipment	9-Terminal Text Edit		-	-	-	1	1	1	1
Typesetter		Cluster Type Compos. Syster	E	-	-	-	-	-	-	1
Editing Man-years 306.7		Typesetter		-	-	-	-	•	1	1
Editing Man-years 36.7 36.7 36.7 36.7 Encoding/		Authoring	Man-years	306.7	306.7	306.7	306.7	306.7	306.7	306.7
ities Encoding/	Personnel	Editing	Man-years	36.7	36.7	36.7	36.7	36.7	36.7	36.7
ities Printing Million pgs 3198.8 31		Encoding/ Composing	Man-years	16.9	16.9	16.9	16.9	16.9	16.9	16.9
ities Printing Million pgs 3198.8 3198.8 3198.8 31 Binding 000s binds 3803.1 3803.1 3803.1 38 Negatives 000s negs 62.0 62.0 62.0 62.0 Plates 74.9 74.9 74.9 74.9		S	Man-years	39.2	39.2	39.2	39.5	39.2	39.2	39.2
ities Printing Million pgs 3198.8 3198.8 3198.8 3198.8 31 Binding 000s binds 3803.1 3803.1 3803.1 38 Negatives 000s plates 62.0 62.0 62.0 Plates 000s plates 74.9 74.9 74.9 74.9	Supplies									
Printing Million pgs 3198.8 3198.8 3198.8 3198.8 31 Binding 000s binds 3803.1 3803.1 3803.1 3803.1 3803.1 38 Negatives 000s negs 62.0 62.0 62.0 62.0 Plates 000s plates 74.9 74.9 74.9 74.9	Facilities									
Binding 000s binds 3803.1 3803.1 3803.1 3803.1 3803.1 38 Negatives 000s negs 62.0 62.0 62.0 62.0 Plates 000s plates 74.9 74.9 74.9 74.9		Printing	Million pgs	3198.8	3198.8	3198.8	3198.8	3198.8	3198.8	3198.8
ves 000s negs 62.0 62.0 62.0 62.0 62.0 000s plates 74.9 74.9 74.9 74.9	Other	Binding	000s binds	3803.1	3803.1	3803.1	3803.1	3803.1	3803.1	3803.1
000s plates 74.9 74.9 74.9 74.9		Negatives	000s negs	62.0	62.0	62.0	62.0	62.0	62.0	62.0
		Plates	000s plates	74.9	74.9	74.9	74.9	74.9	74.9	74.9

A LIST OF RESOURCES REQUIRED FOR THE TEXT EDITOR SYSTEM

TABLE B-6.

N = 10 years

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RESOURCE	RESOURCE	COST OF	RESOUR	SES (IN	THOUSAND	S) WHICH	MUST BE	COST OF RESOURCES (IN THOUSANDS) WHICH MUST BE ACQUIRED IN EACH YEAR	RESIDUAL
DOUB.		-	2	3	4	2	9	N	VALUE
	Rental/lease	113	113	113	113	113	113	113	
Equipment	Maintenance	51	15	15	51	15	15	15	
	Subtotal	164	164	164	164	164	164	164	
	Authoring	6,517	6,517	6,517	6,517	6,517	6,517	6,517	
Personnel	Editing/Encoding	834	834	834	834	834	834	834	
	Comp/Type/Illust.	735	735	735	735	735	735	735	
	Subtotal	8,086	8,086	8,086	8,086	8,086	8,086	980*8	
Supplies	Subtotal								
Facilities	+								
	Subtotal								
	Printing	4,402	4,402	4,402	4,402	4,402	4,402	4,402	
Other	Platemaking	126	126	126	126	126	126	126	
	Subtotal	4,528	4,528	4,528	4,528	4,528	4,528	4,528	
far.	TOTAL COSTS	12,778	12,778	12,778	12,778	12,778 12,778 12,778 12,778 12,778	12,778	12,778	

TABLE 8-7. COST OF RESOURCES REQUIRED FOR TEXT EDITOR SYSTEM

N = 10 years

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TABLE B-8. SUMMARY OF COST OF TEXT EDITOR SYSTEM ANALYSIS (Thousand dollars)

TEN	RESOURCE		00	ST (VALU	E) OF RE	COST (VALUE) OF RESOURCES REQUIRED (RELEASED) BY YEAR	REQUIREC	(RELEAS	SED) BY	YEAR		VALUE OF RELEASED
1104	GROUP	-	2	3	4	2	9	7	8	6	10	RESOURCES
	Equipment	164	164	164	164	164	164	164	164	164	164	
	Facilities	0	0	0	0	0	0	0	0	0	0	
RESOURCES	Personnel	8,086	8,086	8,086	8,086	8,086	8,086	8,086	8,086	8,086	8,086	
REQUIRED	Supplies	0	0	0	0	0	0	0	0	0	0	
	Other	4,528	4,528 4,528 4,528 4,528 4,528 4,528 4,528	4,528	4,528	4,528	4,528	4,528	4,528	4,528	4,528	
	Subtotal	12,778	877,21 877,21 877,21 877,21 877,21 877,21 877,21 877,21 877,21	12,778	12,778	12,778	12,778	12,778	12,778	12,778	12,778	
	Equipment											
RESOURCES	Facilities											
RELEASED	Other											
	Subtotal	0	0	0	0	0	0	0	0	0	0	
NET RESOURCES REQUIRED		12,778	81,21 81,21 81,21 81,21 81,21 81,21 81,21 81,21 81,21 81,21 81,21	12,778	12,778	12,778	12,778	12,778	12,778	12,778	12,778	
DISCOUNT		.955	.868	.789	717.	.652	.593	.539	.490	.445	.405	
DISCOUNTED VALUE		12,203	12,203 11,091 10,082 9,162 8,331 7,577 6,887 6,261 5,686 5,175	10,082	9,162	8,331	7,577	6,887	6,261	5,686	5,175	

Present Value of Alternative - 82,455

The computation of present values via discounting is accomplished by using e following equation:

where 0^{2} is the discounting factor, i is the discount rate (0R), and a stands for the 0R year in the future. For example, if the discount rate ,

stands for the nth year in the future. For example, if the discount rate, is 10 percent and the period is 3 years from now the discount factor is or 0.751. This means that one dellar 3 years from now is worth (1.7). It today.

the neave is an example of an end-of-year discount lactor. Within DOD, wever, a mid-year taptor is used; this is calculated by summing two end-of-ser factors and then dividing by two. For example, looking at table C-1, see end-of-year factor for period 3 is 0.75) (as derived earlier). To get the id-year discount factors for periods to and three i0.326 + 0.75) and then divide by two to get 0.788. All the second tables in this report have mid-year discount factors (Reference 27, second tables in this report have mid-year discount factors (Reference 27,

(90 POT) ZHOTOMA THEODER APPENDIX C

DERIVATION OF MID-YEAR DISCOUNT FACTORS

0.909 - 0.867 0.909 - 0.867 0.751 - 0.788

The computation of present values via discounting is accomplished by using the following equation:

$$DF = \frac{1}{(1+i)^n}$$

where DF is the discounting factor, i is the discount rate (DR), and n stands for the nth year in the future. For example, if the discount rate is 10 percent and the period is 3 years from now the discount factor is or 0.751. This means that one dollar 3 years from now is worth $(1.1)^3$ 75.1¢ today.

The above is an example of an end-of-year discount factor. Within DOD, however, a mid-year factor is used; this is calculated by summing two end-of-year factors and then dividing by two. For example, looking at table C-1, the end-of-year factor for period 3 is 0.751 (as derived earlier). To get the mid-year discount factor for period 3, add the end-of-year factors for periods two and three (0.826 + 0.751) and then divide by two to get 0.788. All the discount tables in this report have mid-year discount factors (Reference 27, pp. 228 through 230).

TABLE C-1. MID-YEAR VS. END-OF-YEAR DISCOUNT FACTORS (10% DR)

Year	End-of-Year Factor	Mid-Year Factor
0	1.000	0.054
1	0.909	0.954
2	0.826	→ 0.867
3	0.751	→ 0.788

APPENDIX D
GLOSSARY OF TERMS

Capital Physical assets having value and utility which extend over

several discrete time periods. Examples are land, equipment,

buildings, simulators.

future costs and benefits. This rate represents the price of money (based on the average interest rate currently

obtainable on loanable funds).

Discount Factor The number (factor) is equal to (1+i)ⁿ, where i is the

discount rate and n is the year being considered.

Discounting A computational technique using the discount rate to calculate

the present value of future benefits and costs. Used in evaluating alternative proposals which have costs and/or

benefits in (over) future years.

Economic Analysis A systematic approach to the problem of choosing how to

employ scarce resources and an investigation of the full implications of achieving a given objective in the most efficient and effective manner. The determination of efficiency and effectiveness is implicit in the assessment

of the cost effectiveness of alternative approaches.

Incremental Cost See Marginal Cost.

Marginal Analysis Technique for evaluating an increment. A basis for comparing

the additional cost to the additional benefit. The term marginal refers to the last increment of whatever is being considered (costs, benefits, units, etc.). Benefits per dollar of cost will be maximized when the value of the incremental benefit equals the incremental cost needed to realize the additional benefit. At any other point, either additional benefits could be obtained at less additional cost or additional benefits obtained would be less than

the additional costs incurred.

Marginal Cost Change in total cost due to a change in output. It is often

used synonymously with incremental costs but the latter is usually considered a more general term. Thus, we speak of the marginal cost of training one additional student or the

incremental cost of introducing a new training system.

Opportunity Cost The benefits (value of a resource) that could have been

The benefits (value of a resource) that could have been obtained by the best alternative use of a resource which has been committed to a specific use. The measurable sacrifice

foregone by forsaking an alternative investment.

Present Value The present worth of past or future benefits and costs deter-

mined by applying discount procedures; this makes alternative programs and actions comparable regardless of time differences

in money flows.

Present Value Benefit Calculation of each year's expected benefits multiplied by its discount factor and then summed over all years of the planning period.

Present Value Cost Calculation of each year's expected cost multiplied by its discount factor and then summed over all years of the planning period.

Resources

Factors of production; inputs used in the production of goods and services. There are three broad resource categories: land, labor, and capital.

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